Hubble Residuals and Host Galaxy Metallicities in an 'Unbiased' Sample

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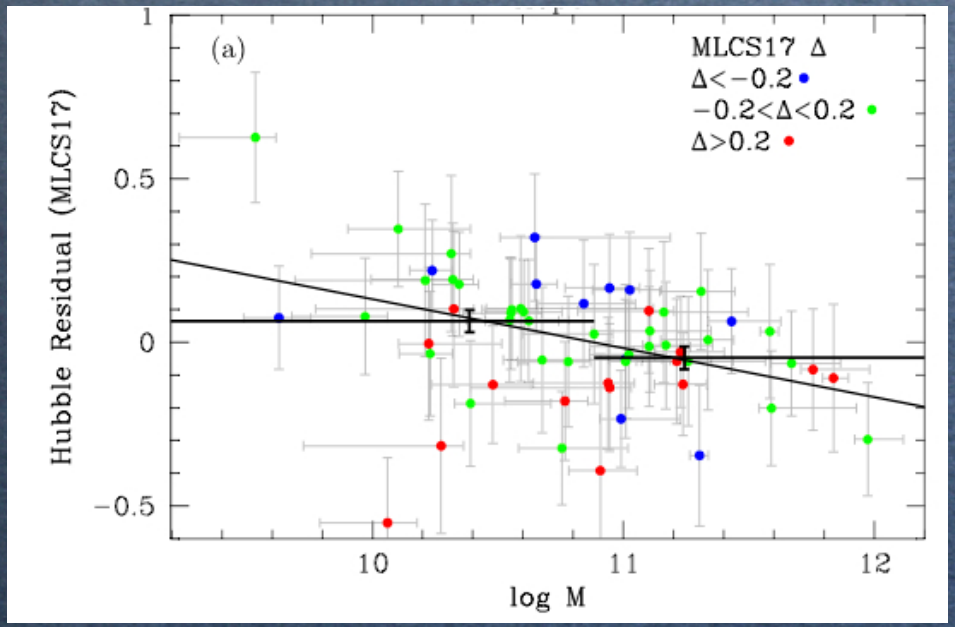
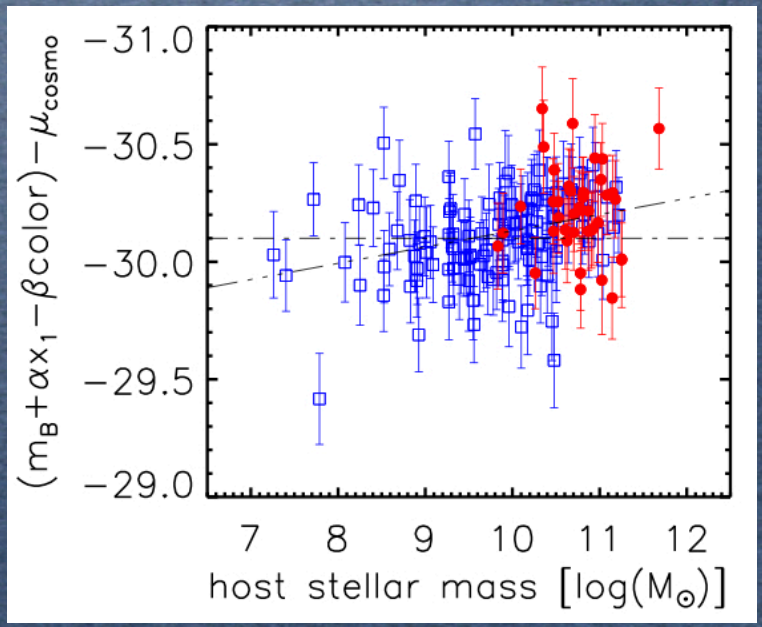
Motivation

- Dependence of SN Ia stretch, rates on Host Type have been shown (Gallagher et al. 2005; Sullivan et al. 2006)
- More recently, overluminosity *after* LC corrections has also been shown to depend on Host properties (Gallagher et al. 2008; Kelly et al. 2010; Sullivan et al. 2010; Lampeitl et al. 2010)

Kelly et al. (2010)



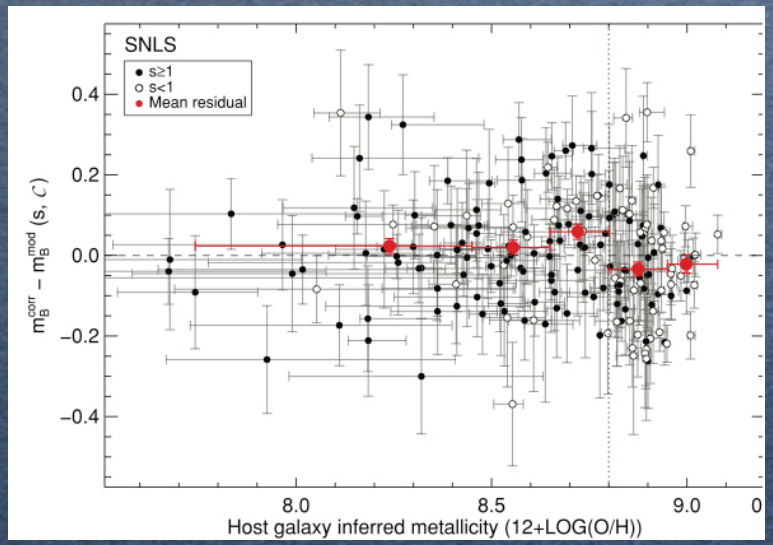
Lampeitl et al. (2010)



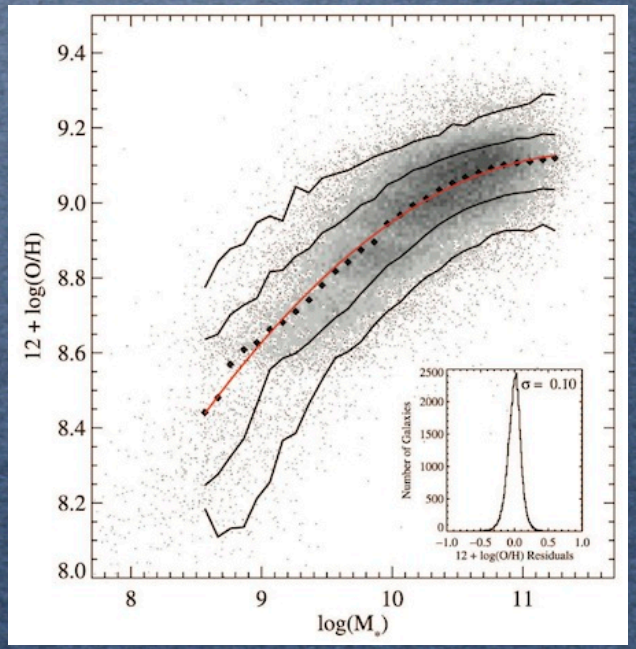
Motivation

- SNe Ia overall luminosity depends on progenitor metallicity, with higher Z producing less ^{56}Ni and a less luminous event (Timmes et al. 2003)
- For a given absolute magnitude, a SN Ia with a higher progenitor metallicity will have a *narrower* LC (Kasen, Ropke, & Woosley 2009)
- Believed that the Host Mass - Hubble Residual correlation is due to progenitor metallicity
- *Has not been directly measured!*

Sullivan et al. (2010)



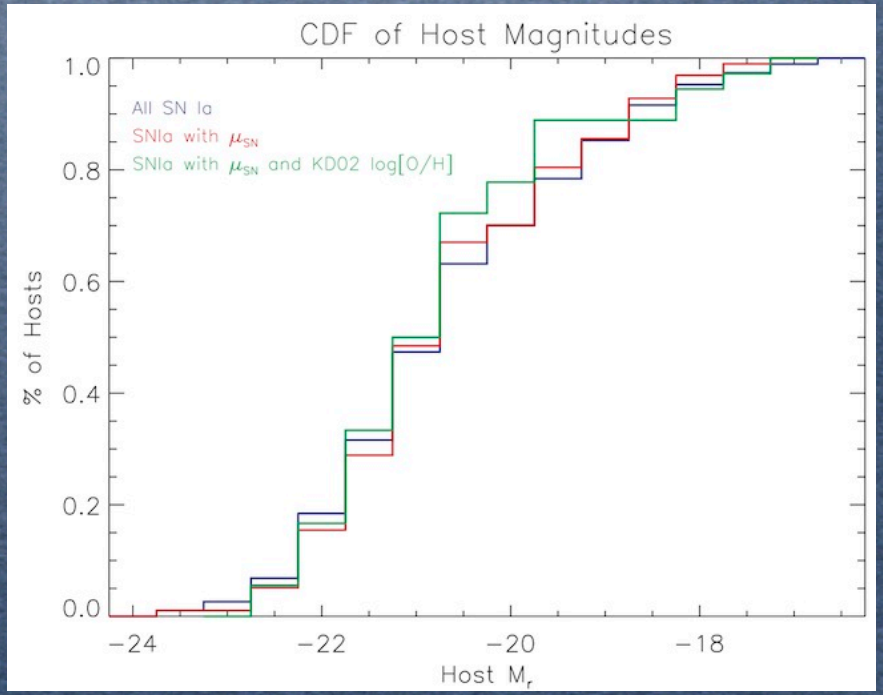
Tremonti et al. (2010)



SDSS-II SNS sample

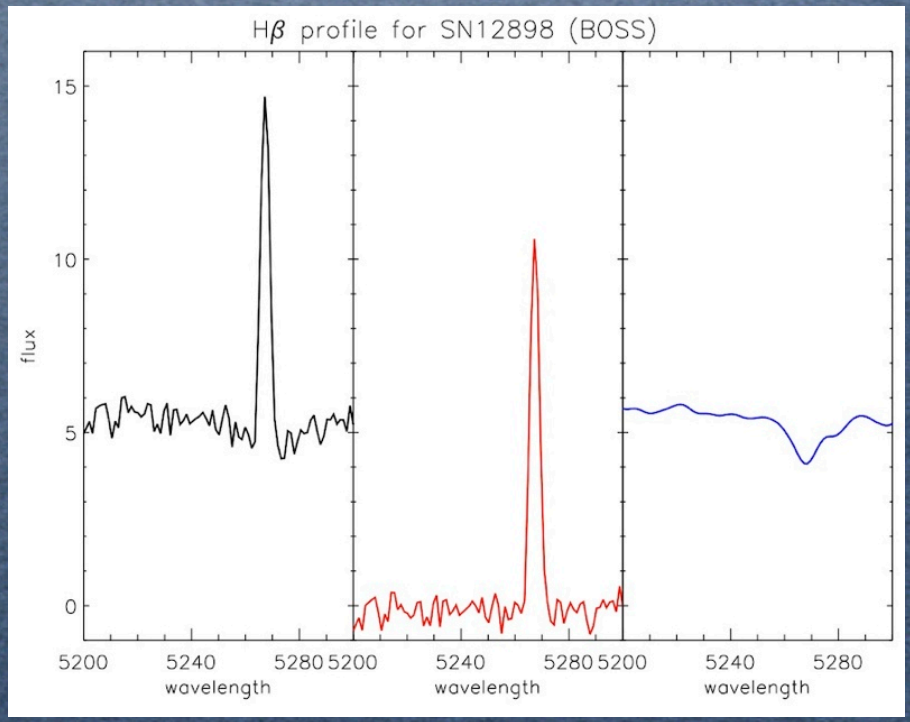
- 'Completeness' - refers to SNe Ia detection efficiency @ z < 0.15 (Dilday et al. 2008)
- Complete sample for this study would be limited to those SNe with Distance Modulus from Light Curve fit
- Galaxy-*only* spectra for 88% of hosts
- Spectra from SDSS-I; BOSS; NTT; APO; GEMINI
- GEMINI sample fills in low-luminosity hosts; expectation is that these are low-metallicity as well

NOTE: Does *not* include 118s or 119s; will be addressed



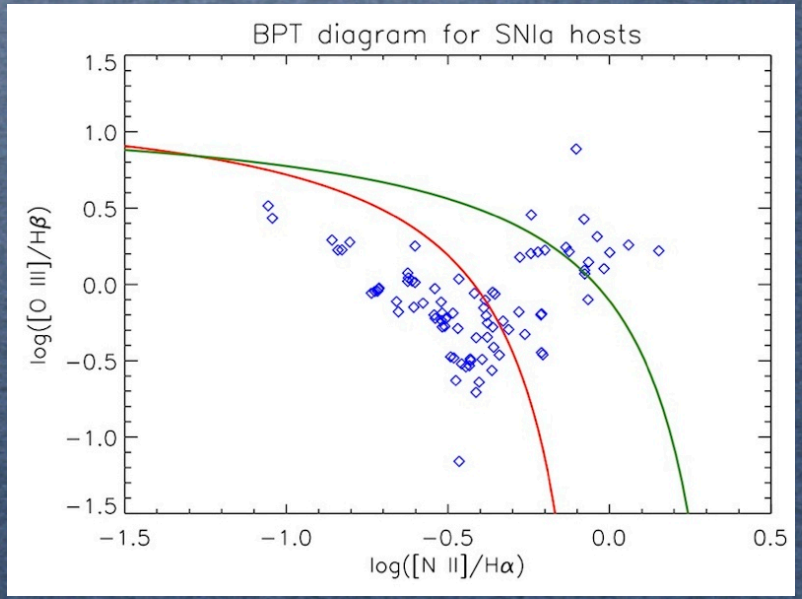
Fitting Process

- Follows that of Tremonti et al. (2004)
  - Mask the emission line regions
  - Find best-fit continuum from large library of models (Z, T, SFH, τ, σ_{int})
  - Subtract continuum; smooth over a sliding window
  - Fit Gaussians to line regions (Balmer lines; Forbidden lines)



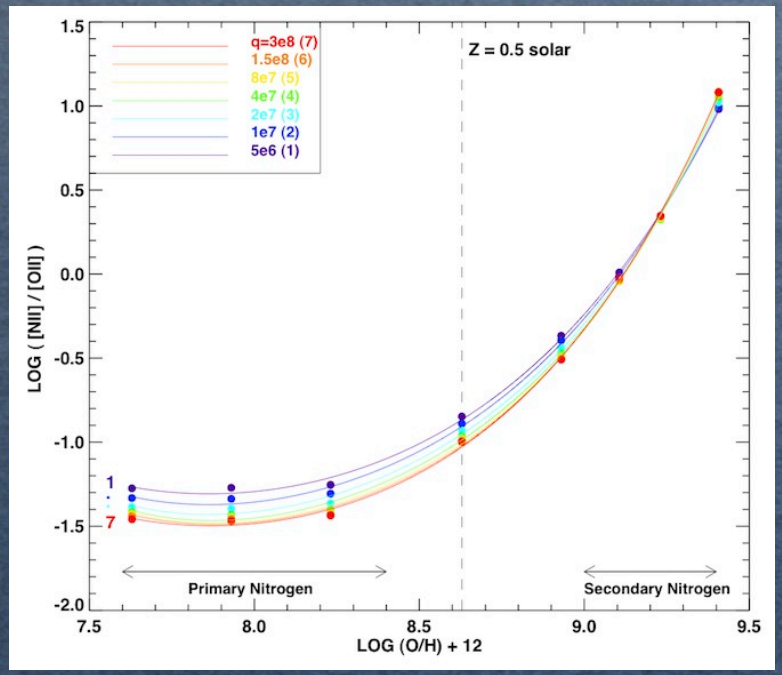
Fitting Process

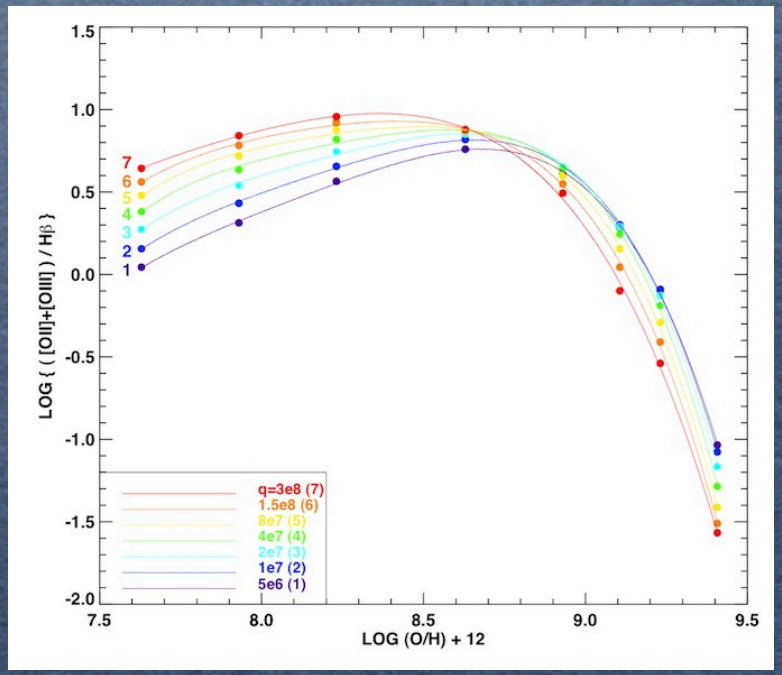
- First Cut - S/N (>5 in Hα; Hβ; [N II] 6584; [O II] 3727)
- Second Cut - BPT diagram (AGN)
  - Keeping 'composite' for now
- Assume Case-B recombination for host reddening (Hα/Hβ) [*EXCEPT* Gemini]
- Third Cut - 'Global' Z
  - Fiber size fixed; cutoff used in Kewley & Ellsion (2008) and Kewley (2005) is 20% g-band
  - Metallicity Gradients exist in spiral galaxies; lower abundances at higher radii (eg., Henry & Worthey 1999)
  - Currently tracking, but not cutting (see plot later...)



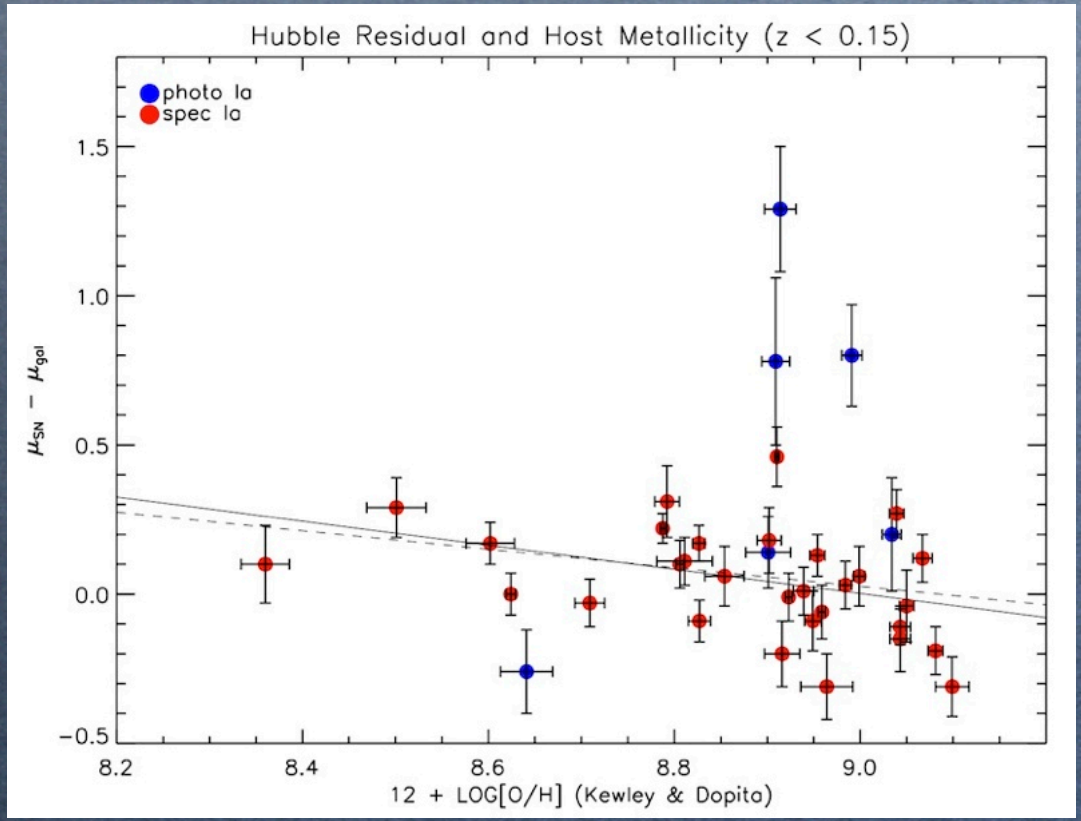
Emission Line Measurements

- Kewley & Dopita (2002): [NII] / [OII]; R_{23}
- R_{23} of M91; KK04 (R_{23} = ([OII] λ3727 + [OIII] λλ4959,5007)/Hβ)
- Depends on models developed using CLOUDY
- Tremonti (2004) uses simultaneous fits to all emission lines; also CLOUDY





Results



Kewley & Dopita (2002) Diagnostic; updated by Kewley & Ellsion (2008)

30 Spec Ia; 6 phot Ia

Trend is detected at ~2.8σ for full sample; ~3.5σ for specIa only

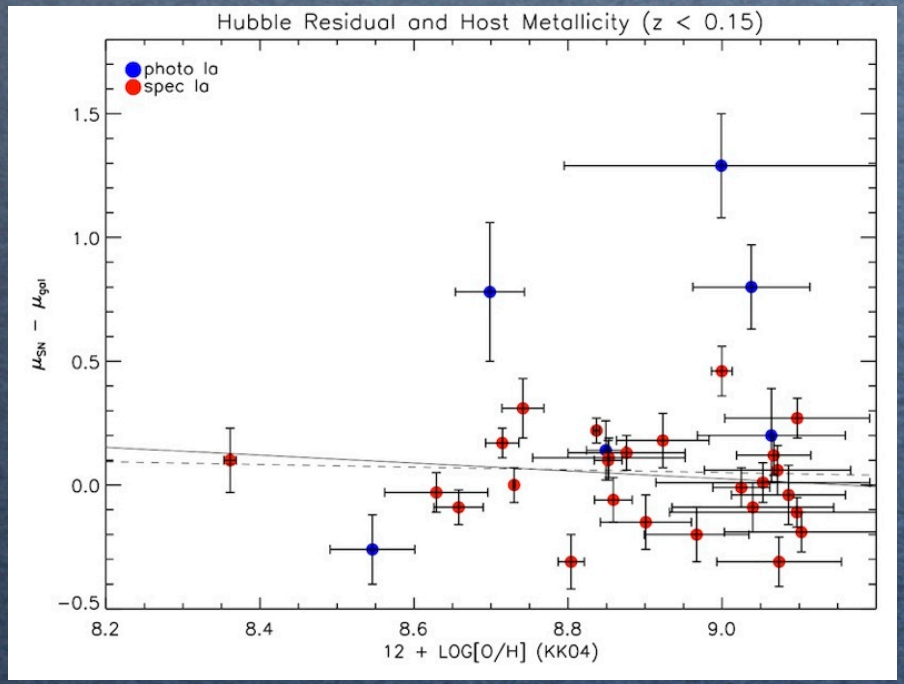
DOES NOT include Gemini spectra

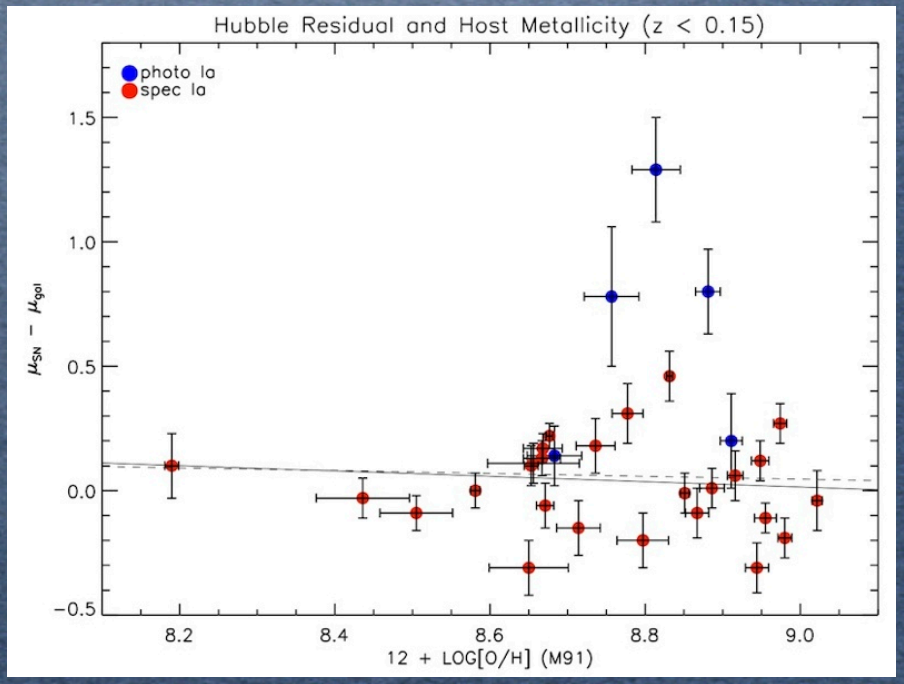
DOES NOT include 118s, 119s

star-forming galaxies only

(less good) Results

- For R23 based methods (KK04; M91), 1σ correlation detected ONLY for KK04 spec-only sample
- Removing the one ~1/2 $Z_\odot$ host, this drops to *no* significance.

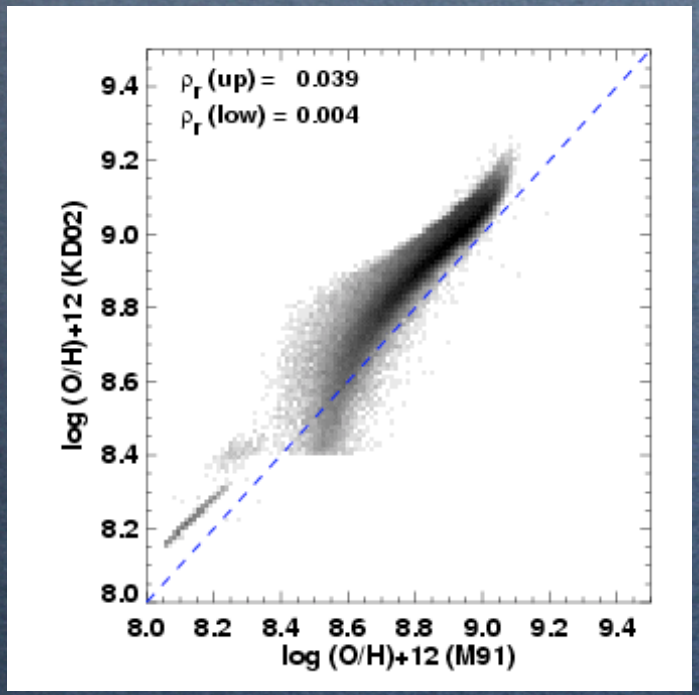


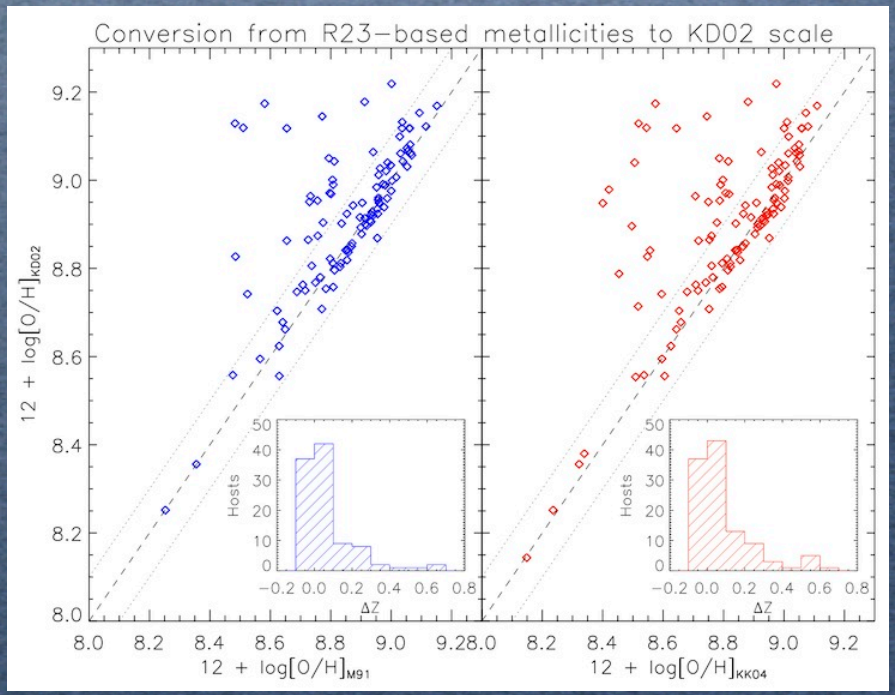


R_{23} Difficulties

I've been able to convert metallicities measured by myself in KD02 system to the Tremonti04 system using KE08 calibration with comparable accuracy to the stated value.

Considerably more scatter - biased - in the conversion from R_{23} based methods to KD02

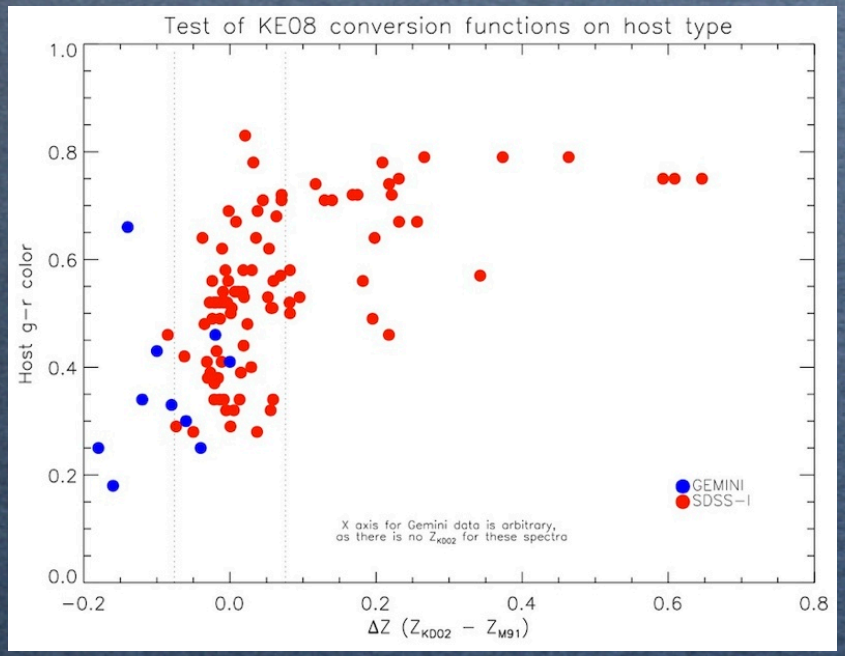


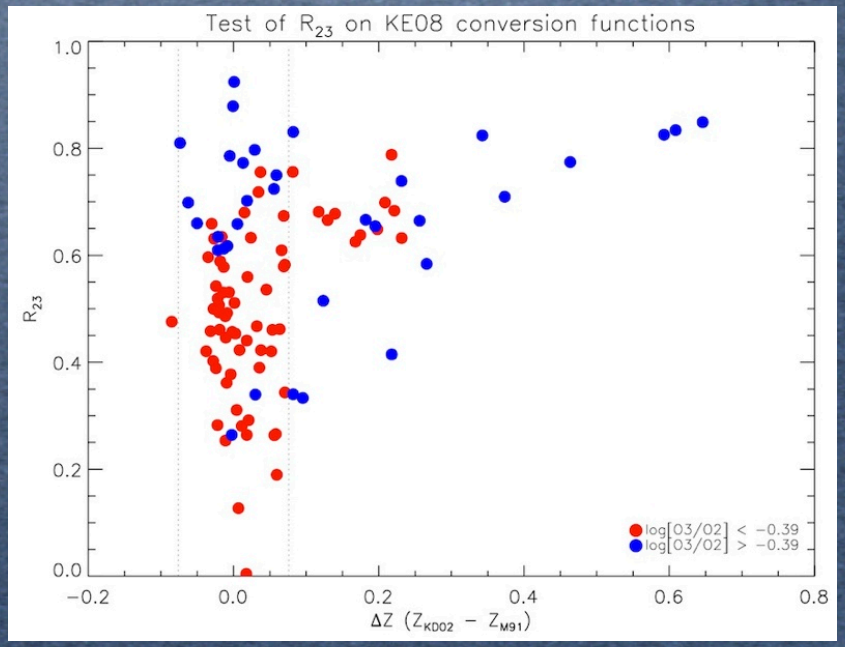


Kewley & Ellison (2008)

Gemini Spectra

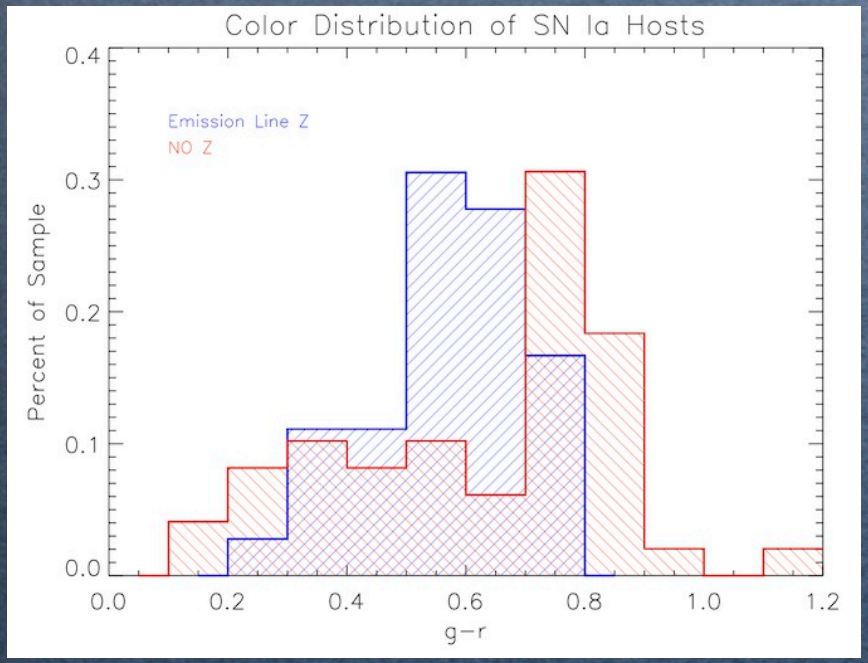
- Observed wavelength range only to ~6600 Å; no Hα, [N II]
- Must use R23; cannot determine branch
- No BPT diagram
- Reddening from Hδ/Hβ
- Conversion functions of KE08 not valid for *all* R_{23} metallicities

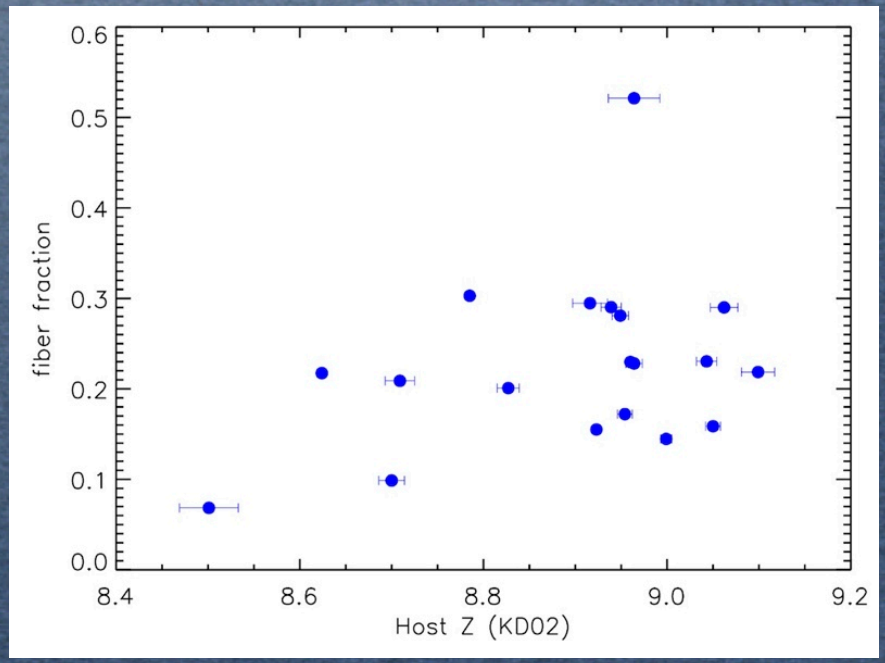




(some) Concerns addressed

- S/N cuts not just a mag cut
- Possible explanation for R_{23} conversion difficulties?
- No inverse correlation between Z and fiber %





To Do

- Immediate: Add in GEMINI spectra in some way
- Almost Immediate: Use Lick indices to get at stellar Z of Ellipticals
- Merely Urgent: Light Curve properties of SN IIP/IIL; Luminosity functions
- then ...

...Graduate